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UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA

In re DYNAMIC RANDOM ACCESS
MEMORY (DRAM) ANTITRUST
LITIGATION

This Document Relates To:

ALL DIRECT PURCHASER
ACTIONS

Case No. M-02-1486-PJH

MDL No. 1486

**MEMORANDUM OF POINTS AND
AUTHORITIES IN SUPPORT OF
MOTION TO EXCLUDE
TESTIMONY OF PAUL C. LIU**

Date: March 22, 2007
Time: 9:00 a.m.
Ctrm.: 3
Judge: Hon. Phyllis J. Hamilton

I. INTRODUCTION AND SUMMARY

Defendants Nanya Technology Corporation (“NTC”), Nanya Technology Corporation USA (“NTC USA”), Mosel Vitelic Inc. (“MVI”) and Mosel Vitelic Corporation (“MVC”) (collectively, the “Nanya and Mosel Defendants”) move to exclude the testimony of Dr. Paul C. Liu, an economist retained by Direct Purchaser Plaintiffs (“Plaintiffs”).

Liu is Plaintiffs’ damages expert.¹ Liu opines, in his second report, based on a series of computer-generated “regression” models, that defendants’ assumed conspiracy to fix DRAM prices resulted in “damages” to the class of between \$2.6 and \$3.0 billion (before trebling). He has also opined at various points that these same “damages” are \$4.2 to \$4.4 billion, or \$2.1 to \$3.6 billion, and various other amounts. Huge variations in damages numbers emerge from Liu’s use of different data sets. Moreover, even slight variations in his assumptions lead to dramatically different results.

The fact that Liu’s damages numbers vary so dramatically and are so fragile itself suggests that there are grave problems with his work. But those problems are the mere tip of the iceberg. Liu’s damages calculations suffer from a series of failures ranging from acknowledged “programming” errors (causing a multi-billion dollar effect) to simple, but scarcely small, errors of arithmetic (such as multiplying when he meant to divide), or relying upon arbitrary assumptions that are not even internally consistent (except, perhaps, in the sense that they uniformly serve to inflate his supposed damages numbers).

Liu’s work also fails basic tests of reliability – not to mention simple common sense. Plaintiffs’ theory is that all defendants conspired to raise the price of all DRAM products throughout the entire class period. If that theory were correct, a proper model would show a positive price effect for any given defendant, for any DRAM product, and for any period of time (putting aside the eight month interval in the middle of the Class Period during which Plaintiffs claim prices were *too low*). As explained below, Liu’s model dramatically fails to exhibit such

¹ Liu has never been qualified as an expert in federal court. *See* Declaration of E. Anne Hawkins in Support of Motion to Exclude Testimony of Paul C. Liu, submitted herewith (“Hawkins Decl.”) Exh. A (Liu Depo. at 1977-11).

consistency. Disaggregating Liu's time, product, defendant, and customer data produces results that are so highly inconsistent and anomalous that the model cannot be given any credence.

In addition, Liu's work reveals another substantial, and by itself disqualifying, error. Although opt-out data was provided to Plaintiffs' counsel to defendants on or about October 10, 2006, Liu's modeling (including his October 24, 2006 model and January 2007 testimony) does not address, perhaps because Plaintiffs' counsel did not disclose to him, the fact that perhaps more than 80% of the sales on which he bases his damages calculation are no longer in the case because of opt-outs. These opt-outs not only reduce the size of the class, but also materially affect its composition, because the opt-outs are not randomly distributed across customer types. When Liu's model is run based on customer types who predominate in the remaining class that is before the Court, no statistically significant price effect appears. Even leaving aside the specific results, Liu's testimony fails because he has not made a study of the damages to the class left in this case, apparently because he was never asked to do so, despite the fact that he has issued two separate reports.

The Court plays a critical gate-keeping function under F.R.E. 702 where expert testimony is offered, because the subject of the testimony, by definition, depends upon scientific or similar expertise not available to laypersons. This function is particularly important in this case where Liu has purported to develop a "but for" world using a highly complex and technical statistical model. The potential to mislead and confuse the jury is immense. The financially life-threatening consequences of the jury misapprehending Liu's testimony, given the joint and several liability and treble damages rules, require exclusion of Liu's testimony given any one of the many problems identified in the discussion below. *See Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993).

II. BACKGROUND FACTS

A. Liu's Initial Report

On August 28, 2006, Liu submitted his initial report regarding his estimation of damages in this case ("Liu Initial Report"), Hawkins Decl. Exh. B. Plaintiffs retained Liu "to determine whether impact can be established, and if so, to estimate total damages, if any, that have accrued

1 or will accrue to the class members in this case.” *Id.* at 2. In performing his damages
 2 calculation, Liu assumed that a “conspiracy to unreasonably restrain trade and commerce in
 3 violation of Section 1 of the Sherman Act, 15 U.S.C. § 1” existed among the defendants and that
 4 the period of the conspiracy is that alleged by Plaintiffs (April 1999 to June 2002). *Id.* at 3.

5 To estimate damages in this case, Liu constructed a mathematical model that was an
 6 attempt to measure the difference between: (i) actual prices and (ii) prices absent the alleged
 7 conspiracy. *Id.* Liu obtained DRAM prices from two data sets: the de Dios reports² and from
 8 transactional sales data produced by Defendants. *Id.* at 8. The de Dios reports purportedly
 9 “include market prices for major customers, second-tier customers, and spot price customers.”
 10 *Id.* Transactional sales data are information supplied by each defendant to Plaintiffs concerning
 11 defendants’ sales of DRAM products. Liu utilized data spanning the entire Class Period, as well
 12 as several years before and after the Class Period (the latter serving as his supposed competitive
 13 “baseline”).

14 Liu could only estimate prices absent the alleged conspiracy, because if such a conspiracy
 15 had existed, prices “but for” the conspiracy are by definition hypothetical. *Id.* at 3-4. To make
 16 this estimation, Liu attempted to compare “a baseline period in which the alleged conspiracy was
 17 absent,” *id.* at 4, with seven separate sub-periods. *Id.* at 10-11.³ He then attempted to fit what he
 18 describes as an economic model of supply and demand to the price data in the baseline period.
 19 In doing so, Liu attempted to control for “the effects of various economic factors on prices.” *Id.*

20 Liu then used this economic model to forecast prices in the Class Period absent the
 21 alleged conspiracy. *Id.* at 4. In reaching his conclusions, Liu aggregated price information
 22 across defendants, customers, and products. Liu attributed any difference between the actual and
 23 forecasted prices to the alleged conspiracy. Liu determined “damages” to be equal to the

24 ² Victor G. de Dios is the Principal at De Dios & Associates, a market research and industry
 25 consulting firm that focuses on semiconductor memory. De Dios & Associates publishes reports
 26 entitled “the DRAM Market Advisor” that contain detailed DRAM pricing information. *See*
 Hawkins Decl. Exh. E (de Dios Report at 1-2).

27 ³ May 1998 to August 1998 (“*transition0*”); September 1998 to March 1999 (“*preclass*”); April
 28 1999 to December 2000 (“*conspire1*”); January 2001 to March 2001 (“*transition1*”); April 2001
 to October 2001 (“*predatory*”); November 2001 (“*transition2*”); and December 2001 to June
 2002 (“*conspire2*”). *Id.*

1 estimated percentage price difference between actual and hypothetical prices, multiplied by
 2 revenues during the period (or periods) in which he found the alleged conspiracy to be effective.
 3 *Id.* Following this process, Liu concluded in his Initial Report “that damages from April 1, 1999
 4 through June 30, 2002 are between \$4.258 and \$4.433 billion ...” *Id.* at 23.

5 **B. Defendants’ Expert Reports**

6 Experts for the various defendants in this litigation, including O’Brien, expert for NTC
 7 and NTC USA, and Dr. Roy Weinstein, expert for MVI and MVC, reviewed Liu’s Initial Report.
 8 On October 2, 2006, O’Brien produced his expert report which commented in part on Liu’s
 9 Initial Report, *see* Hawkins Decl., Exh. F (“O’Brien Report”). The O’Brien Report concluded
 10 that Liu’s Initial Report “suffers from several flaws which make it invalid as a model for
 11 causation and/or damages in this case, both for the Defendants collectively and particularly for
 12 Nanya and Nanya USA.” *Id.* at 4. Weinstein, MVI’s and MVC’s expert, and experts for Micron
 13 and Winbond reached similar conclusions.

14 **C. Liu’s Rebuttal Report**

15 On October 24, 2006, in supposed response to various critiques leveled by defendants’
 16 experts, Liu submitted an entirely new rebuttal report (“Liu Rebuttal Report”), Hawkins Decl.
 17 Exh. C, even though he says that he found nothing in the defense experts’ reports that caused
 18 him to “deviate in any substantive manner from the general framework” of his Initial Report. *Id.*
 19 at 3. In fact, in revising his model, Liu continued to aggregate price information across
 20 defendants and products. He did, however, choose to eliminate the use of the seven sub-
 21 periods,⁴ and altered the underlying sets of data upon which he ran his new regression models.

22 Liu’s Rebuttal Report continued “to find evidence of impact and substantial class-wide
 23 damages.” *Id.* However, upon reevaluation of his model based upon the critiques, Liu
 24 recalculated damages to be in the range of \$2.6 to \$2.9 billion, a reduction of approximately
 25

27 ⁴ Liu has indicated that he does not think his initial use of sub-periods was incorrect. *See*
 28 Hawkins Decl., Exh. C (Liu Rebuttal Report at 5-6); Exh. D (Liu Rebuttal Testimony at 282:22-
 283:11).

1 \$1.6 billion from Liu's initial damage calculation. *Id.* at 60.⁵

2 **III. LIU'S TESTIMONY FAILS TO MEET THE STANDARD FOR EXPERT**
 3 **TESTIMONY UNDER *DAUBERT***

4 Under Federal Rule of Evidence 702 and the standard set forth in *Daubert v. Merrell*
 5 *Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 589 (1993), "the trial judge must ensure that any and
 6 all scientific testimony or evidence admitted is not only relevant, but reliable." A qualified
 7 expert may only provide his opinion if "(1) the testimony is based upon sufficient facts or data,
 8 (2) the testimony is the product of reliable principles and methods, and (3) the witness has
 9 applied the principles and methods reliably to the facts of the case." F.R.E. 702. Fundamentally,
 10 expert testimony must be "sufficiently tied to the facts of the case that it will aid the jury in
 11 resolving a factual dispute." *Daubert*, 509 U.S. at 589, citing *United States v. Downing*, 753
 12 F.2d 1224, 1242 (1985).

13 Liu employs an economic regression model, which in its general form is widely-known
 14 and used by economists. Defendants do not argue that all regression models are inappropriate or
 15 inadmissible. The test under *Daubert*, however, is much more stringent than whether a
 16 generally-known model is used. In *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137 (1999),
 17 the Court upheld a *Daubert* challenge to an expert who used visual inspection to render an
 18 opinion about a car tire. The Court stated that, "contrary to respondent's suggestion, the specific
 19 issue before the court was not the reasonableness *in general* of a tire expert's use of a visual and
 20 tactile inspection to determine whether overdeflection had caused the tire's tread to separate
 21 from its steel-belted carcass. Rather, it was the reasonableness of using such an approach, along
 22 with [the expert's] particular method of analyzing the data thereby obtained, to draw a
 23 conclusion regarding *the particular matter to which the expert testimony was directly relevant.*"
 24 526 U.S. at 153-54 (emphasis in original). Although the Court found that the technique of visual
 25 inspection was acceptable, it was the methodology employed by the expert in analyzing the data
 26 that made the expert's testimony unreliable. *Id.* at 153. Because the problems fell "outside the

27 ⁵ Liu's damages estimate is \$2.9 to \$3.0 billion with an additional "indicator variable" for the
 28 time period April to November 2001. Hawkins Decl., Exh. C (Liu Rebuttal Report at 3).

range where experts might reasonably differ” and were not simply issues that could be fleshed out during cross-examination, the Court held it appropriate to exclude the expert testimony. *Id.*

More specifically, even where economic experts use widely-known models, they are still subject to *Daubert* challenge when they make any of three fundamental mistakes. First, expert testimony is unreliable, and inadmissible, when an expert economist presents a model that fails to take into account facts that (i) could have been incorporate into the model and (ii) call into question the model’s fundamental results. *See, e.g., Nikitas Armorgianos v. National Railroad Passenger Corp.*, 303 F.3d 256, 268-69 (2d Cir. 2002) (excluding expert as unreliable for failure to include available data and to apply proper methodology); *Concord Boat Corp. v. Brunswick Corp.*, 207 F.3d 1039, 1056-57 (8th Cir. 2000).

Second, expert testimony is inadmissible when it does not incorporate all aspects of economic reality and when it does not separate lawful, from unlawful, conduct. *See Craftsmen Limousine, Inc. v. Ford Motor Co.*, 363 F.3d 761, 770-71, 777 (8th Cir. 2004) (excluding damages expert in antitrust action where he assumed all of plaintiff’s injuries were a result of defendants’ behavior and failed to take into account “all aspects of the economic reality” including legal factors contributing to plaintiff’s alleged lost growth); *Concord Boat*, 207 F.3d at 1055-57 (excluding damages expert in antitrust action for failing to distinguish between lawful and unlawful market behavior in estimating an alleged overcharge).⁶

Third, where an economist relies upon evidence that is not itself probative of collusion as a matter of law, and fails to consider external forces that might cause the price “increase” he is attempting to explain, the economist’s testimony will not be admitted. *See Blomkest Fertilizer, Inc. v. Potash Corp. of Saskatchewan*, 203 F.3d 1028, 1038 (8th Cir. 2000); *Blue Cross v.*

⁶ *See also El Aguila Food Products Inc. v. Gruma Corp.*, 301 F. Supp. 2d 612, 620-21, 624 (S.D. Tex. 2003) (excluding damages expert testimony as inadmissible hearsay based on unsupported assumptions where there was no evidence of antitrust injury, and his model failed to disaggregate the effects of defendant’s and others lawful competition); *American Booksellers Assn., Inc. v. Barnes & Noble, Inc.*, 135 F. Supp. 2d 1031, 1039 (N.D. Cal. 2001) (excluding damages expert where information was aggregated improperly and model assumed price differential was due entirely to illegal conduct.); *id.* at 1041-42 (rejecting expert damages model because it “contains entirely too many assumptions and simplifications that are not supported by real-world evidence,” and therefore its conclusions “are entirely too speculative to support a jury verdict.”).

1 *Marshfield Clinic*, 152 F.3d 588, 593-94 (7th Cir. 1998) (excluding expert for failing to correct
 2 damages calculation for non-conspiratorial factors that may have contributed to alleged
 3 overcharge).

4 As in *Kumho*, Liu, while using basic econometrics, has employed a methodology in
 5 analyzing his data that is not reliable, because it ignores important facts or economic realities,
 6 cannot separate lawful from unlawful conduct, generates untenable inconsistencies, and contains
 7 or reflects glaring calculation errors and arbitrary assumptions. Liu's testimony and reports fall
 8 far short of what *Daubert* and *Kumho* permit.

9 **A. Liu's Reported Results Are so Varied and Inconsistent that They Cannot Be**
 10 **Relied Upon as a Basis for Expert Testimony**

11 **1. Liu's new data set dramatically alters the results of his first model**

12 Last August, Liu submitted his Initial Report. In that report, Liu took two different sets
 13 of data – industry data and sales data from the defendants – and divided the Class Period into
 14 seven sub-periods. He then compared the data for each of the sub-periods to other data from
 15 both before and after the Class Period, which he described as a competitive baseline. That
 16 process resulted in supposed damages of between about \$4.2 and \$4.4 billion dollars, before
 17 trebling, depending on the two different data sets.

18 Following receipt of various critiques, in October, Liu submitted an entirely new report.
 19 In that report, Liu abandoned his multiple periods approach in favor of a calculation covering the
 20 entire damage period alleged by Plaintiffs. That new report, which sets forth at least 16 separate
 21 damages calculations, ultimately concludes that damages to the class in this case range from \$2.6
 22 to \$3.0 billion – a change of more than \$1.5 billion dollars from his initial report.

23 Although these differences, standing alone, suggest serious problems with Liu's report,
 24 they do not begin to tell the full story. In his Rebuttal Report, Liu casually announced that there
 25 had been "certain programming errors" in his Initial Report. Hawkins Decl., Exh. C (Liu
 26 Rebuttal Report at 3). "Updating the analysis in my Expert Report to correct for [those]
 27 programming errors gives damages of \$2.6 billion to \$4.5 billion." *Id.* Thus, while the Initial
 28 Report had a swing of \$200 million (\$4.2 to \$4.4 billion), Liu's "programming errors" mask the

1 magnitude of the potential range of nearly \$2 billion in reported outcomes.

2 Moreover, Liu did not merely correct for his programming errors, he also changed the
3 data he was using to run his regression model. He “removed some prices that were not explicitly
4 ‘actual’ prices as well as some price duplicates.” *Id.* at 48-49. He then modified the transaction
5 data by redefining the product types in his data base and eliminating the use of filters. *Id.*
6 Presumably, Liu made these corrections either because he concluded that his original data was,
7 in fact, unreliable (which, if true, would suggest that his testimony should be disqualified for
8 having utilized that unreliable data in the first instance), or at least that he thinks the new data is
9 better.

10 Liu does not indicate what would have happened had he run his original model using the
11 new data, but defendants will: re-running the old model with the new data shows that instead of
12 an “overcharge” of about 30% during what Liu called “Conspire 1” (April 1999 to December
13 2000), the “overcharge” is actually close to 90% – a 300% change. Even more troubling, the
14 “overcharge” in “Conspire2” (December 2001-June 2002) using the de Dios data drops from
15 59% to about 6%, and the transactional sales data goes from a 22% “overcharge” to a 14%
16 “undercharge.” (Notably, it is only for the latter time period that Plaintiffs claim they have
17 evidence as to the Nanya and Mosel Defendants, *see infra* at 10.) *See* Weinstein Decl. ¶ 7. That
18 Liu presented such an unreliable first model (which when paired with his corrected data gives
19 such different results) shows his lack of regard for accuracy, and decisively undermines the
20 credibility of anything he offers.

21 **2. Liu’s model is hyper-sensitive to changes in the baseline period**

22 In his Rebuttal Report, Liu states that he does “not agree that a period of possible
23 conspiracy belongs in the baseline period [the period outside the assumed conspiracy period].”
24 Hawkins Decl., Exh. C (Liu Rebuttal Report at 6-7, n.16). Nevertheless, every model presented
25 in his Rebuttal Report uses a baseline that includes May 1998 through March 1999, a period that
26 Noll and Liu claim is tainted by evidence of conspiracy. *See* Weinstein Decl. ¶¶ 9-11, Ex. C.

27 It is an appropriate econometric test to make changes to model inputs, including baseline
28 periods, and observe the results. When the May 1998 through March 1999 period is excluded

from the baseline, as Liu suggests it ought to have been, Liu's model yields dramatically lower "overcharge" estimates. *See id.* ¶ 11. Moreover, even those reduced "overcharge" estimates *are not statistically significant* when the allegedly tainted period is removed from the baseline. *See id.* Hence, Liu's model is hyper-sensitive to changes in the baseline period and is not admissible because it is neither robust nor reliable. *See* Hawkins Decl., Exh. K (Liu, "Chapter VII: Damages," in *Econometrics: Legal, Practical, and Technical Issues* (ABA 2006) at 172) (model should be robust to the inclusion/exclusion of a data point).

B. Liu's model improperly pools categories of information

In reaching his damages calculation, Liu also "pools" certain categories of information. As he explains, the "data are generally individual transaction data which include product description, revenue, units sold and approximate date of a sale or group of sales along with a description of the customer, though certain data are more aggregated." Hawkins Decl., Exh. B (Liu Initial Report at 9). Specifically, Liu ran his model measuring the alleged "price elevation" on prices with a single aggregating measure (the variable Liu now calls "Class Period") which pools across (i) all of the defendants, (ii) all of the various DRAM products, (iii) over the entire Class Period, and (iv) all DRAM sales to all class members, despite the fact that at least 154 class members have opted out of this litigation. *See* O'Brien Decl. ¶ 30.

Pooling data to estimate a common effect in and of itself does not necessarily make a model unreliable. However, a standard and necessary step in any econometric analysis is to determine whether the effect being estimated by pooling is in fact common across the data being pooled. *See* O'Brien Decl. ¶ 10. Although the math may be complex, the underlying concept is straightforward: if the theory that is offered for the whole of the data is sound (*i.e.*, statistically predictive), then reasonably similar results should obtain for its various parts. If that is not true, then there is something fundamentally unreliable about the model.

As an example, if an economist estimates a common discrimination impact on the salaries of Hispanic and African-American employees in a discrimination case, it is standard economic practice to verify that those two groups showed reasonably similar results before relying upon a commonly estimated effect. If the different pooled factors behave vastly different from each

other, then it is not proper to rely on the aggregated results. *See id.* ¶ 11. In the same example, one might find that Hispanic wages were, in fact, suppressed, but that African-American wages were not. A failure to perform this step of the analysis, or performing the step but ignoring results showing marked differences, fails to meet a basic econometric standard and should be disqualifying without more. *See id.* ¶¶ 11-12. Moreover, it makes the result unreliable for either group. *Cf. American Booksellers*, 135 F. Supp. 2d at 1039-40 (rejecting damages model in Robinson-Patman price discrimination case because it averaged the effects of purportedly discriminatory sales prices of many manufacturers and wholesalers in order to show that *on average* plaintiffs were harmed).

1. Liu's model improperly pools time periods

Although Liu's Initial Report included seven different time sub-periods, in response to criticism received from defense experts,⁷ many of Liu's new model runs use a single Class Period indicator variable. Liu Rebuttal Report at 51. Liu averages the alleged price elevations calculated in these iterations, and, in doing so, concludes "that the most likely impact is between 16 and 18 percent." *Id.*

However, this pooling is only appropriate if one first confirms that the pooled time periods belong together. If one tests Liu's pooled model by disaggregating the time periods, the results indicate that the periods which he has pooled together are wildly disparate in terms of Liu's prediction of the alleged overcharge. According to Plaintiffs' allegations, NTC and NTC USA joined the alleged conspiracy in August 2001.⁸ Yet during the period from April 1, 1999 to July 31, 2001 (*prior* to NTC/NTC USA's alleged joining), Liu's model shows an "overcharge"

⁷ Defense experts, including O'Brien, have not opined that the use of sub-periods in a model is itself improper or unreliable, at least to test whether there is a common effect. *See, e.g.,* Hawkins Decl., Exh. F (O'Brien Report at 31-33). If a common effect is determined, then it could be appropriate to use a single class period. However, if a common effect is not shown through testing by disaggregating the class period into sub-periods, then the allegation of a class-wide conspiratorial effect must be rejected. *See supra* at 9.

⁸ There is no evidence in this case, and Plaintiffs have not argued, that NTC or NTC USA participated in any DRAM industry conspiracy from the beginning of the Class Period. To the contrary, at the hearing on NTC's and NTC USA's Motions for Summary Judgment, counsel for Plaintiffs, Anthony Shapiro, argued that NTC's/NTC USA's alleged participation in the alleged conspiracy did not begin until the late summer of 2001. Hawkins Decl. Exh. G (Hearing Transcript at 43:9-45:22).

1 of more than 40%, while during the August 2001 to June 2002 period, the model shows no
 2 statistically significant overcharge at all. *See* O'Brien Decl., Exh. C. Moreover, for the first of
 3 these two periods, the model inexplicably shows an NTC/NTC USA "overcharge" of more than
 4 100%,⁹ while for the second period of time (in which Plaintiffs allege NTC and NTC USA
 5 conspired), Liu's model shows an NTC/NTC USA "undercharge" of over 40% and an
 6 MVI/MVC "undercharge" of about 10%. *See* O'Brien Decl., Exhs. D1 and D2. When O'Brien
 7 performed the standard econometric test as to whether pooling the two time periods was
 8 economically appropriate, the test conclusively rejected the appropriateness of pooling these
 9 results. *See id.* ¶¶ 20-26.

10 By disaggregating the time period, it is clear that the time periods are not similar, and
 11 cannot be pooled together for a single reliable result. In essence, aggregating the time periods, as
 12 Liu has done, takes the model's finding that there was a significant "overcharge" prior to
 13 Plaintiffs' allegation of the Nanya Defendants joining the conspiracy, and leverages it to find an
 14 "overcharge" after their alleged entry into the conspiracy, *even though on its own that second*
 15 *period shows no such effect.*¹⁰ By failing to run a disaggregated test, or failing to disclose that
 16 the disaggregated data showed a different outcome, Liu's model reaches an improper conclusion
 17 that an 18.5% overcharge extended across the entire Class Period.

18 **2. Liu's model improperly pools products**

19 Liu's model purports to establish the alleged "overcharge" for all DRAM products.
 20 DRAM, however, is not a single product. Rather, Liu received data for 137 product types, and
 21 kept the top 80 "because of estimation issues." Hawkins Decl., Exh. D (Liu Depo at 222:7-14).
 22 Disaggregating the alleged "overcharge" on a product-by-product basis reveals that only a small
 23

24 ⁹ Meanwhile, Liu's model indicates that Micron, a much larger manufacturer than NTC/NTC
 25 USA (new market entrants at the time) or MVI/MVC, had a statistically insignificant
 26 "overcharge" during this period of around 6%. Apart from econometrics, this result lacks
 common sense.

27 ¹⁰ At the core, this approach is akin to grouping someone of relatively short stature (*e.g.*, former
 28 Labor Secretary Robert Reich) with Shaquille O'Neill and LeBron James and calculating that, on
 average, all three men are over six feet tall. In truth, two of them are, and one is not. Lumping
 them together serves only to confuse the finder of fact.

number of products actually exhibit positive coefficients that are statistically significant.¹¹ And in fact, not unexpectedly, Liu's decision to pool across these products is invalidated by the standard statistical test proposed by O'Brien. *See* O'Brien Decl., Exh. B. The product-specific price changes generated by Liu's model range from -93% to +342%, thus varying by over 400 percentage points. Without a demonstrable common effect across product types, Liu's aggregated model does not pass econometric muster, and the appropriately disaggregated test (even accepting Liu's model, which is flawed in other ways) shows that Plaintiffs' alleged global conspiracy had a significant effect on only a small fraction of the products in suit.

Plaintiffs' own liability expert, Professor Noll, has conceded that "[a]n economic analysis of the impact of the conspiracy can address whether collusion in setting prices applied only to some products and customers, *in which case it might not have affected all prices to all customers.*" Hawkins Decl., Exh. H (Noll Class Cert. Report at 6 ¶ 14) (emphasis supplied). The Court as well has recognized that Plaintiffs must prove injury and damage to all members of the class. *See* Class Certification Order at 12, citing *Bogosian v. Gulf Oil Corp.*, 561 F.2d 434 (3d Cir. 1977), and *In re Bulk [Extruded] Graphite Prods. Antitrust Litig.*, 2006 WL 891362 (D.N.J. Apr. 4, 2006). In fact, so far as the evidence of record shows, some customers – particularly smaller, spot-market or "Tier 2" customers who have not opted-out of the class – may have purchased only those DRAM products for which Liu's model shows no "overcharge." Thus, as with the time period pooling, Liu's product pooling masks crucial underlying data variation, and also fails to satisfy both this Court's and Plaintiff's own liability expert's requirement that injury and damage be proven for particular customers (or at least groups of customers).

Besides invalidating the use of pooling, a simple review of the results of the un-pooled analysis shows that Liu's model cannot possibly be capturing the true underlying economics of

¹¹ If a product has a statistically significant, positive coefficient, that means that Liu's model finds a statistically significant correlation between "elevated" pricing for that product and the assumed conspiracy. However, if the coefficient is not statistically significant, no inference of correlation can be drawn. *See* O'Brien Decl. ¶ 9. Usually, economists speak of statistical significance at the 95% confidence level, meaning that the probability that a particular measured effect is actually zero is no greater than 5%. *Id.* at ¶ 42.

the DRAM industry. In addition to the vastly divergent price effects across different products, the difference in price effects related to similar products demonstrates the unreliability of Liu's model. For example, two of the products listed are 256MB_DDR_SoDIMM and 256MB_DDR_ReDIMM.¹² These products are sufficiently similar that they are readily substitutable for each other in the marketplace with small modification post-manufacture. As a result, it would be difficult for one to be priced conspiratorially high unless the other were as well, since they are such close substitutes. O'Brien Decl, ¶ 17. However, Liu's model suggests that SoDIMM has a negative and statistically significant coefficient, while ReDIMM has a positive and statistically insignificant coefficient. In other words, Liu's model says that one of these products is associated with an "overcharge," while one is not associated with either an "over-" or "undercharge." Assuming the existence of a conspiracy, it does not make economic (or common) sense that one product would be significantly undercharged, while a substitutable product would have an overcharge that is effectively close to zero. *Id.* Similar results are revealed in the "Alleged Overcharge by Product Type During Class Period" chart (*id.*, Exh. B), which shows wildly divergent results for many product types (*e.g.*, 16 MB SDRAM types). These divergent results likely indicate that the class effect which Liu is measuring is, in fact, influenced by variables not captured in Liu's model, and that the "class period" effect cannot reasonably be assumed to measure conspiratorial damages. *See id.* ¶¶ 18-19.

3. Liu's model improperly pools defendants

The third type of pooling test is, perhaps, the most damning. Having assumed a conspiracy among all defendants, Liu's model lumps all DRAM manufacturers together when measuring the alleged "price elevation." This might be sensible if the assumption that all defendants were conspiring were correct. However, for the same reason, it is something that an expert would want to test for to see if the assumption is supportable. If the test showed that results varied greatly among the defendants, that result would indicate either that (a) the

¹² These two products are both 256 megabyte "double-date rate" DRAM products. One is assembled in a small dual "in-line" module configuration ("SoDIMM," or small outline dual inline memory module) while the other is not. *See* <http://computing-dictionary.thefreedictionary.com/SODIMM>; <http://acronyms.thefreedictionary.com/RDIMM>.

1 assumption of a conspiracy is simply wrong, or (b) that the regression model is flawed and has
 2 no reliable predictive value in assessing damages. Either flaw is a fatal one for Plaintiffs.

3 In fact, disaggregating the firms demonstrates that they were not performing in a
 4 remotely similar fashion. *See* O'Brien Decl., Exhs. D1 and D2. The standard econometric test
 5 for whether pooling is appropriate generally rejects defendant/manufacturer pooling, meaning
 6 that the econometrically correct approach is to estimate each firm's effect separately. *See id.* ¶¶
 7 27-29. Doing so results in wildly divergent results for each firm, which, besides rendering
 8 pooling invalid, should have also cautioned Liu that his underlying assumption about common
 9 defendant behavior was incorrect. For example, for the period August 1, 2001 to June 30, 2002,
 10 when one disaggregates the data by manufacturer, the results are that NTC/NTC USA exhibit an
 11 approximately 45% "undercharge," while MVI/MVC show a more than 10% "undercharge."
 12 *See id.* Exh. D2. And for the time period December 1, 2001 to June 30, 2002, the results are an
 13 approximately 45% NTC/NTC USA "undercharge," and no statistically significant "overcharge"
 14 for MVI/MVC and several other manufacturers. *See* O'Brien Decl., Appendix F at 29.¹³ While
 15 Liu assumes a conspiracy for the purposes of his model, the result reached by disaggregating the
 16 defendants should have signaled to him that this assumption was unreasonable. By refusing to
 17 investigate the unreasonableness of his assumptions, Liu crosses the line from an expert to an
 18 advocate, and is offering inadmissible testimony. *See, e.g., Concord Boat*, 207 F.3d at 1056-57;
 19 *American Booksellers* at 1041-42.

20 At a common sense level, when it is indeed appropriate to pool together data (for the
 21 purpose of measuring a common effect), disaggregating that data will yield results which, while
 22 somewhat different in magnitude, are not fundamentally at odds. One can assume joint and
 23 several liability among antitrust defendants¹⁴ but nevertheless identify, manufacturer by
 24 manufacturer, whether each manufacturer's prices moved as alleged. Faced with the fact that
 25

26 ¹³ One gets similar, but not identical, results if one uses two sub-periods instead of three. *See*
 27 O'Brien Decl., Exhs. D1 and D2. It seems that every time one slightly adjusts a parameter of
 28 Liu's model, the output of the model is substantially affected. This indicates the model is neither
 robust nor reliable.

¹⁴ *See generally Texas Industries, Inc. v. Radcliff Materials, Inc.*, 451 U.S. 630 (1981).

1 according to Plaintiffs' own model, one firm's prices did not show the same effect as the prices
 2 of various other firms, it is hard to see how a jury could even be asked to conclude that the
 3 divergent firm had participated in any conspiracy. Moreover, in any event, the results of
 4 disaggregation undermine any proof of common impact on all class members. The question of
 5 which class members were harmed is answered very differently when the fact that a given firm's
 6 prices were unaffected (and thus none of its customers were harmed) while other firms'
 7 customers were harmed. It is no answer to this point that joint and several liability makes each
 8 defendant liable for the entire conspiracy (including effects caused by other defendants) and thus
 9 eliminates the need to look at each firm's prices. Proof of impact on *all* class members is still
 10 necessary – and that proof is lacking based on Liu's data and analysis.

11 **4. Liu's model improperly pools customers and thus fails to analyze the**
 12 **correct class**

13 Another significant problem with Liu's model in terms of his overall damages number, as
 14 well as his analysis, is his pooling together of all sales in his dataset, whether those sales were to
 15 class members or to opt-outs. Liu states in his Initial Report that the class he uses in his model
 16 consists of: "All individuals and entities who, during the . . . Class Period . . . purchased DRAM
 17 in the United States directly from the defendants or their subsidiaries." Hawkins Decl., Exh. B
 18 (Liu Initial Report at 2). Throughout this litigation, however, a significant number of customers
 19 have opted-out of the class. Most of the "major" buyers are included in this opt-out group.¹⁵ At
 20 no time, however, does Liu eliminate these customers from the class or re-run his model to
 21 determine what the impact, if any, this would have.

22 At a fundamental level, Liu's failure to isolate the class members means that his
 23 conclusion that there is a significant "price elevation" for class members simply has not been
 24 tested scientifically. That is a failure of proof, pure and simple. Moreover, there is no reason to
 25 believe that those who are "out" (of the class) and those who are "in" look the same. To the
 26 contrary, one can get a sense of the impact of excluding opt-outs by looking at Liu's de Dios

27 _____
 28 ¹⁵ For example, Dell, Inc., Apple Computer, and Sun Microsystems, among many others, have
 all opted out of the class. See Hawkins Decl., Exh. J.

models, which differentiate among three groups: major customers, second-tier customers, and spot market customers. Liu aggregates all three groups in reaching his overcharge conclusion. However, when the three groups are disaggregated, however, the result is much different, showing (i) no “price elevation” for certain customers, and (ii) *no statistically significant effect* on either the spot market customers (for either weighted version of the model estimated by Liu) or for so-called second-tier customers (for one of the weightings). *See* O’Brien Decl. ¶¶ 30-32. It is only when the “price elevation” aggregates Tier 1 OEM customers – the vast majority of whom are no longer members of the class – that Liu’s model shows a significant effect. *See id.*, Exh. E. The single estimate reported by Liu represents, in effect, an average “overcharge” across all customer types. However, such averaging cannot possibly be a proper measure of the effect on this class, because many of the customers who contributed most strongly to a statistically significant effect in Liu’s model have opted out of the litigation. Including non-class members in a measure of class impact invalidates the result, just as, in the previous employment example, including Asian Americans in the measure of Hispanic price discrimination would distort the underlying truth. In this respect, Liu’s model ignores facts that (i) could have been incorporated into the model and (ii) call into question the model’s fundamental results. *See, e.g., Concord Boat*, 207 F.3d at 1056-57; *see also American Booksellers*, 135 F. Supp. 2d at 1039-40 (rejecting damages model because it improperly averaged effects on plaintiffs).

Additionally, in his second deposition, Liu testified that it did not matter to him that the composition of the class had changed. *See* Hawkins Decl., Exh. D (Liu Depo. at 311:10-313:20). Liu, however, calculates his damages amount by multiplying the alleged overcharge percentage by the number of units sold. All sales to customers who have opted-out of the class must be taken out of this equation. This would necessarily reduce the damages number, even if the “impact” to class-members and opt-outs was identical. Although defendants do not have exact figures, in part because Samsung did not identify customers by name in its transactional sales data, the opt-outs must result in a reduced sales base of at least \$7.8 billion, resulting in at least \$1.2 billion less in “overcharges” at Liu’s 18.5% rate, *see* O’Brien Decl. ¶¶ 33, fn. 20, or as much as a \$16.6 billion reduction in the sales base, leaving only \$2.5 billion in the class, or \$471

1 million in “overcharges,” assuming the share of sales to class members who are no longer in the
 2 case is equal to the average share for Hynix, Infineon, Samsung, and NEC/Elpida. *See*
 3 Weinstein Decl., ¶ 24.

4 Liu uses Noll’s Liability Report as a shield, repeatedly stating that he assumes Noll’s
 5 liability finding in creating his model. Noll himself, however, emphasizes that any damage
 6 finding would need to demonstrate impact by product and by defendant. Specifically, Noll states
 7 that after finding collusion, one must determine “whether the collusion affected the prices paid
 8 by *all* customers for *all* DRAM products.” Hawkins Decl., Exh. H (Noll Report at 5) (emphasis
 9 supplied). Thus, according to Plaintiffs’ own liability expert, any damages expert would have to
 10 show price effect for *all* customers and *all* products used in the damages base. By pooling
 11 customers as well as products, Liu has masked the fact that he has not shown a price effect for all
 12 customers and products, and that his model consequently fails the basic economic criterion
 13 advanced by Plaintiffs’ own liability expert.

14 **C. Liu’s Model Fails to Distinguish Between Lawful and Unlawful Behavior**

15 Liu states that for purposes of his Initial and Rebuttal Reports, he assumed “that the
 16 defendants entered into a conspiracy to unreasonably restrain trade and commerce in violation of
 17 Section 1 of the Sherman Act, 15 U.S.C. § 1.” Hawkins Decl., Exh. B (Liu Initial Report at 3).
 18 Liu’s model, as explained above, identifies any residual price differential not already controlled
 19 for as a function of the alleged conspiracy. Liu’s model, however, does not and cannot
 20 determine whether there are numerous explanations for the residual price increase.

21 As Liu assumes, the residual price increase could be a result of illegal communications
 22 between manufacturers. On the other hand, the residual price could be the result of entirely legal
 23 communications between manufacturers and customers. Customers can, of course, lawfully tell
 24 one supplier the prices being offered by another supplier. *See 7-Up Bottling Co. v. Archer*
 25 *Daniels Midland Co. (In re Citric Acid Litig.)*, 191 F.3d 1090, 1103 (9th Cir. 1999), citing
 26 *United States v. United States Gypsum Co.*, 438 U.S. 422, 421 n.16 (1978). Liu’s model,
 27 however, cannot discriminate between illegal and legal exchanges of information. That is,
 28 although Liu assumes unlawful price communications (as outlined in Plaintiffs’ complaint and in

the Noll Report), he cannot distinguish between a world in which allegedly unlawful price communications occurred and one where, at least to some extent, the same price information was lawfully shared by customers.¹⁶ Thus, there is no way to use Liu's model to determine whether the residual price increase is relevant to the issues in this litigation – namely, whether they are in fact the result of an illegal conspiracy among DRAM manufacturers. Nor can the model disaggregate any unlawful impact from other lawful elevations, if a jury were to determine that both types occurred and affected prices. Although Liu assumes a conspiracy, he cannot rely upon that assumption to avoid the fact that his model is equally consistent with lawful information exchanges as it is with unlawful information exchanges. *Cf. Concord Boat*, 207 F.3d at 1057 (expert liability testimony is inadmissible when it does not incorporate all aspects of economic reality and when it does not separate lawful, from unlawful, conduct).

D. Liu's Model Is Replete with Substantial Calculation or Data Errors

Liu's model is built on a number of substantial calculation or data errors or anomalies. Each alone is significant. In combination, they compel the conclusion that the model does not square with reality, is not robust, and hence is not reliable.

1. Liu's model reflects a web starts error

One of the factors Liu attempts to control for on the demand side is the number of web servers sold. Web servers use DRAM, so increasing web starts generally indicates increasing DRAM demand. However, Liu relies upon an inappropriate data set for web starts, and thus arrives at a flawed estimate of DRAM demand.

Specifically, Liu's data source for web starts does not actually measure the number of new web servers purchased in a given time period, so Liu's efforts to craft a demand variable produces something other than what he appears to be measuring. Liu meant to control for the demand for new web starts. Instead of obtaining information on actual new web starts, however,

¹⁶ Neither Noll nor Liu can eliminate the possibility that price information was lawfully shared by DRAM customers with their suppliers. Noll cannot do so, because (i) he analyzed only certain communications between certain defendants, and did not purport to conduct an inquiry into the flow of all pricing information, and (ii) his analysis of particular price communications is not the proper subject matter of expert testimony. Liu cannot do so, because he merely *assumes* the existence of an inchoate global conspiracy.

1 his data source consists of a web server survey. This survey actually measured the number of
2 host or domain names that could be reached via the internet, rather than new computers sold.
3 *See* O'Brien Decl. ¶ 40. Because several domain names can be associated with a given server
4 (and vice versa), the survey is, at best, only an imperfect indicator of the demand for DRAM web
5 servers. Liu's data set was not an acceptable proxy for the variable for which he intended to
6 control. By itself, this is perhaps a relatively minor problem, but Liu has not taken the necessary
7 step to ensure that his approximation does not cause mischief in his results.

8 An analysis of Liu's model demonstrates that during two months just outside of the class
9 period, the assumptions Liu made to convert his data into a proxy for new web servers are simply
10 detached from the reality of the industry. During July and August 2002, the total number of
11 domain names decreased by more than Liu's assumed replacement factor. Thus, his web server
12 measure predicts that a negative number of web servers were sold, a result which neither makes
13 the slightest sense nor fits into the assumptions underlying his model. Because Liu's model
14 utilizes logarithms, and because one cannot take the log of a negative number, Liu had to "force"
15 the model to assume exactly one web server was sold. (This, of course, is a highly improbable, if
16 not impossible, assumption.) The log of one is zero, so Liu uses zero as a placeholder in his
17 regression and assumes that doing so does not affect his overall results. *See* O'Brien Decl. ¶¶ 35,
18 40, Exh. F.

19 Liu's decision to use zeroes here skewed his numbers and the perceived impact of the
20 alleged conspiracy upward. Dropping those two months entirely from his estimation of the
21 transaction data (which is a quick test of the model's robustness, *see* Hawkins Decl., Exh. K at
22 169-73, decreases by approximately 25% Liu's calculated "overcharge," *see id.*, resulting in a
23 reduction of the "overcharge" of about \$602 million. Moreover, the resulting "price elevation"
24 predicted is no longer statistically significantly different from zero. Liu's method for dealing
25 with the clearly erroneous data was not appropriate from an economic standpoint and highlights
26 how sensitive any residual measure of the alleged Class Period price elevation is to specification
27 of other variables, because all Liu can measure is that which is unexplained by his other
28 explanatory variables. Rather than taking the appropriate steps to address the two-month gap, or

1 to step back and devise a better measure of the underlying driver of demand, Liu chose an
 2 implausible assumption that skewed his result by hundreds of millions of dollars. *See id.*

3 **2. Liu makes a serious error in his calculation of supposed output**
 4 **restriction as a result of a simple mathematical error and his reliance**
 on an unsupportable measure of price elasticity

5 In his Rebuttal Report, Liu undertook an analysis related to output and price elasticity of
 6 demand, for the purpose of testing whether his model's "price elevation" results were consistent
 7 with the economic reality of the DRAM industry, and with Liu's own estimates of changes in
 8 output. However, because of two errors (one of which Liu acknowledged at his deposition), his
 9 conclusion that his models fall within a range of values consistent with industry facts and
 10 economic literature is entirely mistaken.

11 Liu performed an analysis that was intended to measure whether there was "a reduction
 12 in DRAM output compared to historical trends" during the Class Period. Liu Rebuttal Report
 13 39. Leaving aside other critiques of Liu's model (including the critique that his output reduction
 14 estimate is itself fundamentally flawed, *see infra* at 22), Liu reports that his analysis reveals a
 15 7.0% average "decline" in output during the Class Period. *Id.* 43. He then multiplies a range of
 16 reported price elasticities by this result, and concludes that a 7.0% decrease in output would
 17 result in a predicted range of "10.5 to 16.1 percent price elevation." *Id.* He then opines that this
 18 is "broadly consistent" with his de Dios and transaction data analyses. *Id.*

19 However, as Liu testified in his rebuttal deposition,¹⁷ this range of percent price
 20 elevations is based on an inadvertent miscalculation concerning price elasticities. The
 21 relationship between price, quantity, and elasticity is a basic concept in economics: elasticity
 22 represents the percentage change in quantity for a given percentage change in price.
 23 Consequently, if one has an estimate of a percentage change in quantity, and an estimate for
 24 elasticity, one can *divide* the quantity by the elasticity to get an estimate of the resulting
 25 percentage change in price. However, Liu *multiplied*, rather than divided, the elasticity factor.¹⁸

26 ¹⁷ *See* Hawkins Decl., Exh. D (Liu Depo. at 210:22-211:12; 258:13-259:20).

27 ¹⁸ In other words, since ϵ (the elasticity) equals $\Delta Q/Q$ (the percentage change in quantity) divided
 28 by $\Delta P/P$, (the percentage change in price), then $\Delta P/P = \Delta Q/Q / \epsilon$. Liu testified that he
 inadvertently used $\Delta P/P = \Delta Q/Q * \epsilon$ instead.

1 Simply fixing Liu's arithmetic error by dividing (rather than multiplying) by the elasticity
 2 estimates results in an estimated range of price changes from 3.0% to 4.7%, as opposed to 10.5%
 3 to 16.1%. That result most certainly is not "broadly consistent" with the de Dios and transaction
 4 data analyses. It is, instead, yet another huge red flag as to the reliability of Liu's work.

5 But Liu is nothing if not resourceful. Dividing by a smaller elasticity, by definition,
 6 would create a higher price "elevation." Liu's estimates of price changes actually rely on a body
 7 of economic literature cited in the Expert Report of Micron's expert, Professor Carl Shapiro,
 8 which states a range of price elasticities from 1.5 to 2.3.¹⁹ However, in his recent deposition, Liu
 9 testified that the bottom end of this range of elasticities was incorrect. Instead of 1.5, he now
 10 asserts that the appropriate range of elasticities should reach as low as 0.5. This is certainly
 11 convenient for Liu, since this revised elasticity would create a higher price "elevation," thus
 12 providing him with an equally convenient escape hatch for his admitted arithmetic error
 13 (multiplying instead of dividing). Liu's basis for this new approach is a paper by Dr. Kenneth
 14 Flamm. As cited in Professor Shapiro's expert report, Flamm is reported to have "...reported a
 15 range of estimates from 0.5 to 2.5, but used 1.5."²⁰ However, Flamm's range of estimated
 16 elasticities is not actually 0.5 to 2.5 but rather 1.5 to 2.1. *See* Weinstein Decl. ¶ 21.²¹

17 Therefore, the range reported by Shapiro, and subsequently relied upon by Liu, reflects a
 18 fundamental error. When this error is corrected, the range of values reported from the literature
 19 becomes 1.5 to 2.3, identical to the range that Liu originally reported in his Rebuttal Report. *See*
 20 *id.* Thus, there is no evidence that the range of elasticities on which Liu relied in his Rebuttal
 21 Report should be changed. Put simply, Liu's purported escape hatch does not exist.

22 Using the original range of elasticities, and performing the appropriate calculation (*i.e.*,
 23

24 ¹⁹ Hawkins Decl. Exh. G (Shapiro Report at 6, n.22).

25 ²⁰ *Id.*

26 ²¹ *See* Flamm 1993, pages 68-69. Flamm also cites past literature, which he states shows a range
 27 between 1.6 and 2.3. Nowhere does Flamm report the low elasticity value of 0.5, nor in fact
 28 does he report any value below unity (*i.e.*, an elasticity of 1.0). On pages 66-68, Flamm also
 estimates a "learning curve" elasticity with values around 0.5, but this parameter relates to the
 rate at which costs decline with cumulative output, and has nothing to do with the analysis of
 price elasticity. *See* Weinstein Excl. Decl. ¶ 21, Exh. G.

division rather than multiplication) provides a range of expected price changes between 3.0% to 4.7%. This range is clearly not consistent with the range of estimates that Liu used for his calculation of alleged damages, 16.0 percent to 20.9 percent,²² nor is it consistent with his full range of estimates, from 8.5% to 26.3%. Liu's models' estimates of "price elevation" are far outside the range implied by the findings in the economics literature. *See* Weinstein Decl. ¶ 22, Exh. H.

In short, correcting for Liu's multiplication/division error results in an average "overcharge" of 3.0% to 4.7%, rather than 18.5%. Such an "overcharge" percentage corresponds to a total "overcharge" of only \$582 million to \$892 million, rather than the \$2.6 to \$3.0 billion found by Liu.

3. Liu's model relies upon an unsupported reduction in output measurement

Throughout his calculations, Liu repeatedly picks and chooses the data that best fit his hypothesis that an alleged conspiracy resulted in an increase in DRAM prices, often with little underlying economic justification. Liu's estimate of the alleged reduction in output during the Class Period is a prime example.

Liu uses a so-called fourth-order polynomial²³ in arriving at his output reduction estimate, which he uses in connection with elasticity estimates to arrive at a range of alleged price elevations. *See supra* 20. Specifically, Liu uses a fourth-order polynomial time trend in his model, without providing any discussion of why he did so. No economic theory dictates the use of a fourth-order polynomial, and Liu, notably, did not choose to use that specification when measuring the time trend in his main models. *See* Weinstein Decl. ¶¶ 12-17. Indeed, aside from an exercise in curve-fitting, it is hard to imagine why Liu would introduce this type of time trend

²² Hawkins Decl., Exh. C (Liu Rebuttal Report, Tables 8 and 13).

²³ A polynomial is an algebraic equation. Polynomials are described as having "orders," *i.e.*, a second-order polynomial varies according to the square of a variable. A fourth-order polynomial varies according to the fourth power of a variable. *See* Weinstein Decl. ¶ 12, fn. 7. In his output model, Liu includes the number of months since January 1996, just as he does in his price model, but he also adds the square of that number, the cube of that number, and that number raised to the fourth power.

1 into his model. A fourth-order polynomial trend produces the largest output reduction estimate
 2 of any choice of polynomial, and is the only order of polynomial that even produces a
 3 statistically significant estimate. *See id.* ¶ 17. Moreover, and tellingly, had Liu used a fourth-
 4 order polynomial in his pricing models, his model would have shown no statistically significant
 5 price “elevation.” *See id.* Proper econometrics does not allow for this kind of arbitrary (or
 6 worse, not so arbitrary) picking and choosing. Liu provides no logic for why time should be
 7 modeled as a first-order polynomial when measuring the alleged conspiratorial impact on price,
 8 but as a fourth-order polynomial when measuring the alleged conspiratorial impact on output, for
 9 a single industry with identical supply and demand factors and common conspiracy allegations.
 10 Liu’s choice of a fourth-order polynomial is not only arbitrary but appears calculated to yield the
 11 largest output reduction estimate possible. *Cf. Champagne Metals v. Ken-Mac Metals, Inc.*, 458
 12 F.3d 1073, 1078-80 (10th Cir. 2006) (excluding plaintiff’s economic expert where he offered no
 13 explanation for his underlying methodology.)

14 IV. CONCLUSION

15 For the reasons stated above, the Nanya and Mosel Defendants respectfully request that
 16 the Court preclude Liu from testifying in this matter. If the Court is unwilling to exclude Liu
 17 from testifying on the basis of the parties’ briefs, the Nanya and Mosel Defendants in the
 18 alternative request that the Court conduct a hearing on the admissibility of Liu’s testimony.

19 Dated: February 15, 2007

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